REMARKS

Claims 1-25 are pending in the application, of which claims 1-18 are allowed. Claims 19-23 and 25 are withdrawn from consideration as directed to a non-elected species. Claim 24 is amended. Applicant requests reconsideration and allowance in view of the above clarifying amendment and the following remarks.

Claim 24 is rejected under 35 U.S.C. 102(b) as allegedly being anticipated by Nissan, JP 10169526, a computer-generated translation of which is enclosed for the Examiner's reference. The Examiner directs Applicant's attention to the English language abstract and Figure 8 of JP '526 and notes that claim 24 "does not require the injector [to] be mounted in the intake manifold and the location of Nissan's injector will allow for a direct conductive path to the injector, since the injector is not identified as being conductively insulated." Applicant respectfully requests reconsideration and withdrawal of this rejection.

The present amendment clarifies that the direct heat conduction path and the electrical heater heat the end region of the injector but not the body of the injector. The purpose of heating of the injector in the present invention is to elevate the temperature of the fuel in the end region so that as soon as the fuel leaves the tip of the injector, the fuel immediately converts to vapour because of the heating of the end region and the change in pressure experienced by the fuel as the fuel leaves the tip of the injector. Claim 24 specifically defines a delivery system which has an injector port and a fuel injector located in the injector port. The claim now further defines an electrical heating element connected with the end region of the injector for heating the fuel in the end region of the injector but not the body of the injector. Applicant stresses that the claim requires the fuel in the end region to be heated by the electrical heating element. Thus, the requirement in claim 24 is that the fuel in the end region be heated both by the electrical heating element and by direct conduction from the engine. The body of the injector, however, is not heated, which therefore means that the electronic componentry in the body is not destroyed by heat when the fuel in the end region is heated to a sufficiently high temperature to cause the immediate vaporization when the fuel leaves the injector tip.

The Japanese reference, in contrast, is concerned with a direct injection system where fuel is supplied directly to the cylinder of the engine rather than through an air inlet port. The

Japanese reference explains that in order to provide this direct injection, the fuel injector valve 37 consists of two or more components such as a fuel revolution component and nozzle components. The Japanese specification explains that in this type of system, temperature management over the two different components cannot be properly performed so that under low temperature, a temperature gradient exists between the combustion chamber and the environment outside the combustion chamber at the time of cold starting. Because the coefficient of thermal expansion of the components is in fact different, heat deformation occurred, which impaired proper injection of the fuel and combustion of the fuel in the cylinder. The purpose of the invention in the Japanese specification is to prevent degradation of the injection property of the fuel because of heat deformation of the various components of the fuel injection valve. In order to reduce the temperature gradient which occurs in very cold weather, the Japanese specification proposes an electrical heating element which is embedded in the cylinder head near the injector. This therefore warms the outside environment to thereby reduce the temperature gradient and overcome the problems associated with the thermal expansion of different parts of the injector valve. The Japanese reference does indicate there is another advantage that fuel is warmed during the cold temperature start. However, the Japanese reference certainly does not disclose that the heating of the fuel is sufficient to cause immediate vaporization upon ejection of the fuel from the injector.

The invention defined by claim 24 distinguishes from the Japanese reference by at least the following features:

(a) The electrical heating element is connected with the injector end region.

(b) The heat conducting path from the engine to the end region for heating the end region.

(c) Both forms of heating heat the end region but not the body of the injector.

(d) Furthermore, the heating is sufficient to cause the fuel to immediately vaporize when it leaves the injector.

In the Japanese specification, the heating takes place by conduction from the heating element 19 through the various components of the system. Amended claim 24 requires the electrical heating element to be connected with the injector to avoid the need to heat by conduction at initial engine start up.

The reason for this is that the present invention provides for heating of the end region of the injector during normal running by conduction. However, at initial startup when little heat is available, heat conduction from the engine to the end region is not sufficient to elevate the temperature of the fuel to the required temperature to produce vaporization when the fuel is ejected from the injector. In order to ensure that there is immediate heating of the fuel upon startup, the electrical heating element is connected with the injector end region so the injector end region is immediately heated to, in turn, immediately heat the fuel in the end region so that proper vaporization occurs upon injection while the engine is relatively cold.

The present invention is not concerned with heating the environments of the engine to avoid the thermal expansion issues described in the Japanese specification but, rather, to ensure that there is immediate increase in temperature of the fuel in the end region of the injector at startup until sufficient heat is generated so that heat is conducted via the conduction path from the engine to the end region to maintain the fuel in the end region at the required temperature to produce the vaporization when the fuel is ejected from the injector. Further still, the Japanese reference does not describe the supply of heat to only the end region of the injector and not the body of the injector. This is important in the present invention because the present invention is heating the fuel to a relatively high temperature, as distinct from overcoming cold start problems at approximately -20°C. Typically the fuel in the end region of the injector in the present invention is heated to a temperature in the order of 88°C-220°C. If the body of the injector were heated to this temperature, the electronic componentry in the body of the injector would more likely than not be destroyed, thereby preventing operation of the injector.

Contrary to this, the heating in the Japanese specification is when the temperature is typically below 0°C (and down to -20°C). Once the temperature reaches 0°C or higher, the heating by the heater 19 is stopped. Thus, in the Japanese reference, the heating is relatively low and is being performed to reduce thermal deformation in very cold weather rather than being used to heat the fuel in the end region of the injector to a relatively higher temperature for the purpose of causing immediate vaporization of the fuel when the fuel leaves the injector.

Thus, the effect in the Japanese reference is to warm the environment around the injector outside of the chamber to prevent the thermal gradient which causes different thermal expansion of components because of their different coefficients of thermal expansion. In the present invention the requirement is to ensure immediate heating of the fuel in the end region of the

injector and to do this, the electrical heating element is connected with the end region so heat is immediately supplied to the end region, rather than attempting to heat the surrounds of the injector as in the Japanese reference. Accordingly, Applicant requests reconsideration and withdrawal of the rejection.

In view of the foregoing, Applicants submit that all claims are in condition for allowance, and timely notice to that effect is respectfully requested.

Respectfully submitted,

KENNETH M. FAGIN
Reg. No. 37615
Tel. No. (301) 721-2583
Fax No. (301) 560-8880

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CLAIMS

[Claim(s)]
[Claim 1] The injection type spark-ignition engine in a direct cylinder characterized by establishing a heater means to heat said fuel injection valve, in the injection type spark-ignition engine in a direct cylinder which attaches a fuel injection valve in the cylinder head, and becomes it at a combustion chamber that a direct fuel should be injected, and making it operate this heater means at the time of cold machine starting.
[Claim 2] Said heater means is an injection type spark-ignition engine in a direct cylinder according to claim 1 characterized by being laid under said cylinder head.
[Claim 3] Said heater means is an injection type spark-ignition engine in a direct cylinder according to claim 1 characterized by being built in said fuel injection valve.
[Claim 4] Said heater means is an injection type spark-ignition engine in a direct cylinder according to claim 1 characterized by being built in the seal member for gas leakage control infixed between said fuel injection valves and said cylinder heads.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the injection type spark-ignition engine in a direct cylinder which attaches a fuel injection valve in the cylinder head, and becomes it at a combustion chamber that a direct fuel should be injected.
[0002]
[Description of the Prior Art] As a conventional injection type spark-ignition engine in a direct cylinder, what was indicated by JP,6-207542,A is known, for example. The outline configuration is explained with reference to drawing 8 .
[0003] In this drawing, 31 is a cylinder block and is fitted in the interior of a cylinder block 31 free [sliding of a piston 32]. Crevice 32a is formed in a part of crestal plane (top face) of a piston 32. The cylinder head 33 is attached in the upper part of a cylinder block 31.
[0004] An ignition plug 34 is attached in the outline center section, and the exhaust air passage 36 which has the inhalation-of-air passage 35 and exhaust valve 36a which have inlet-valve 35a in the location of the outside of an ignition plug 34 is formed in the cylinder head 33. Outside, the fuel injection valve 37 is attached at the pan of the inhalation-of-air passage 35 of the cylinder head 33. A fuel injection valve 37 injects a fuel directly into the combustion chamber formed by the inside of a cylinder block 31, the crestal plane of a piston 32, and the inside of the cylinder head 33.
[0005] By adopting such a configuration, by injecting a fuel towards crevice 32a of the crestal plane of a piston 32 in the compression stroke last stage from a fuel injection valve 37 at the time of operation on low loading conditions, a combustible gas mixture is formed only in the field to which the circumference of an ignition plug 34 was restricted, and lean combustion is realized.
[0006] In order to make the suitable combustible gas mixture only for the field to which the circumference of an ignition plug 34 was restricted form, the fuel oil consumption of a fuel injection valve 37 and the accuracy of spraying structure (spraying configuration) are required. For this reason, the point of a fuel injection valve 37 (that near is included.) It is below the same. It is constituted by two or more components so that process tolerance can be made high.
[0007] That is, the point of a fuel injection valve 37 consists of two or more components, such as a fuel revolution component which makes it circle in the injection fuel prepared inside this injection tip of the nozzle components with which the plunger which opens and closes this injection tip was inserted, the nozzle acceptance components which receive these nozzle components, and these

nozzle components, while having an injection tip.
[0008] Moreover, in case a fuel injection valve 37 is attached in the cylinder head 33, he is trying to prevent that infix the gas-seal member which has a gas-seal function between a fuel injection valve 37 and the cylinder head 33, pass the fuel injection valve mounting hole of the cylinder head 32 from a combustion chamber, and gas is revealed.
[0009]
[Problem(s) to be Solved by the Invention] However, if the conventional injection type spark-ignition engine in a direct cylinder which mentioned above has Since temperature management of the point of the fuel injection valve constituted with two or more components cannot be performed, Under a large low temperature service (for example, outside air temperature: -10 degrees C - -20 degrees C), the temperature gradient of combustion chamber inside and outside at the time of cold machine starting When the heat deformation (coefficient of thermal expansion) of each part article which constitutes the point of a fuel injection valve differed, dispersion was produced in the injection property of a fuel and there was a trouble that combustion stability got worse as the result.
[0010] It explains to a detail with reference to the concrete data furthermore shown in drawing 9 . Drawing 9 is a graph which shows the property of the injection engine in a direct cylinder in contrast with the injection engine in a port. Here, an axis of abscissa is engine temperature (degree C), and the axis of ordinate shows the amount of combustion pressure fluctuation in the cylinder in which an engine's combustion stability is shown (sigmaPi).
[0011] Since the heat deformation of each part article which constitutes the point of a fuel injection valve by the temperature gradient of the point of a fuel injection valve and a combustion chamber becoming large becomes less uniform [the injection engine in a direct cylinder] as shown in this drawing when engine temperature becomes low temperature from -20 degrees C, Since the dispersion width of face of injection properties, such as dispersion, fuel oil consumption, and spraying structure (spraying configuration), becomes [the relative physical relationship of a plunger (needle valve) and a fuel injection tip] large, cylinder internal pressure fluctuation becomes large rapidly, and combustion stability gets worse.
[0012] When combustion stability gets worse, not to mention an engine output declining, the noise is made to increase and there is also a possibility that a unburnt gas may be discharged further.
[0013] This invention is made in view of such a point, and aims at offering the injection type spark-ignition engine in a direct cylinder excellent in the injection property of the fuel at the time of cold machine starting, and combustion stability.
[0014]
[Means for Solving the Problem] In order to attain the purpose mentioned above, in the injection type spark-ignition engine in a direct cylinder which attaches a fuel injection valve in the cylinder head, and becomes it at a combustion chamber that a direct fuel should be injected, the injection type spark-ignition engine in a direct cylinder of this invention according to claim 1 establishes a heater means to heat said fuel injection valve, and is characterized by making it operate this heater means at the time of cold machine starting.
[0015] According to the injection type spark-ignition engine in a direct cylinder of this invention according to claim 1, since a fuel injection valve is heated with a heater means at the time of cold machine starting and it was made to raise the temperature of a fuel injection valve, the temperature gradient of the fuel injection valve and combustion chamber at the time of cold machine starting can be made small, and heat deformation of each part article which constitutes a fuel injection valve can be made small.
[0016] Therefore, degradation of the injection property accompanying heat deformation of each part article is prevented, and the combustion stability at the time of cold machine starting can be improved. Moreover, since not only the fuel injection valve itself but the fuel of the interior will be heated indirectly, the fluidity of the fuel at the time of cold machine starting becomes good and the atomization of spraying is promoted, a heater means can also aim at improvement in the injection

property by this.
[0017] The injection type spark-ignition engine in a direct cylinder of this invention according to claim 2 is characterized by laying said heater means under said cylinder head in the injection type spark-ignition engine in a direct cylinder according to claim 1.
[0018] The installation of the heater means of the injection type spark-ignition engine in a direct cylinder according to claim 1 will be pinpointed concretely, and a fuel injection valve will be heated through this cylinder head by the heater means laid under the cylinder head in this case.
[0019] The injection type spark-ignition engine in a direct cylinder of this invention according to claim 3 is characterized by building said heater means in said fuel injection valve in the injection type spark-ignition engine in a direct cylinder according to claim 1.
[0020] The installation of the heater means of the injection type spark-ignition engine in a direct cylinder according to claim 1 will be pinpointed concretely, and a fuel injection valve will be directly heated in this case by the heater means built in this fuel injection valve.
[0021] According to the injection type spark-ignition engine in a direct cylinder of this invention according to claim 4, in the injection type spark-ignition engine in a direct cylinder according to claim 1, said heater means is characterized by being built in the seal member for gas leakage control infixed between said fuel injection valves and said cylinder heads.
[0022] the installation of the heater means of the injection type spark-ignition engine in a direct cylinder according to claim 1 is pinpointed concretely, and a fuel injection valve is boiled with the heater means built in the seal member for gas leakage control infixed between this fuel injection valve and the cylinder head, and is heated.
[0023] Since according to the injection type spark-ignition engine in a direct cylinder of this this invention according to claim 4 in addition to improvement in combustion stability it can respond only by exchange of a seal member to the conventional injection type spark-ignition engine in a direct cylinder, a large design change is not needed for other parts and the number of components does not increase, either, the rise of cost can be suppressed to the minimum.
[0024]
[Effect of the Invention] According to the injection type spark-ignition engine in a direct cylinder of this invention according to claim 1 to 3, degradation of the injection property accompanying heat deformation of each part article which constitutes a fuel injection valve is prevented, and it is effective in the ability to improve the combustion stability at the time of cold machine starting. Moreover, since the fuel in a fuel injection valve will also be heated indirectly, it is effective in the ability to also aim at improvement in the injection property by this. Therefore, the fall of an engine output, the increment in the noise, and extensive discharge of a still more poisonous unburnt gas can be prevented.
[0025] Moreover, according to the injection type spark-ignition engine in a direct cylinder of this invention according to claim 4, in addition to the above-mentioned effectiveness, it is effective in the ability to suppress the rise of cost to the minimum.
[0026]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained to a detail with reference to a drawing. Drawing 1 thru/or drawing 5 are drawings for explaining the injection type spark-ignition engine in a direct cylinder concerning the 1st operation gestalt of this invention. First, the sectional view showing the important section configuration of drawing 1 is referred to.
[0027] In drawing 1 , 11 is the cylinder head, and although the cylinder head 11 is omitting illustration, it is being fixed to the upper part of the cylinder block with which the piston by which the crevice was formed in a part of the crestal plane (top face) was fitted in.
[0028] Moreover, although illustration is omitted at the cylinder head 11, an ignition plug is attached in the outline center section, and the exhaust air passage which has the inhalation-of-air passage and the exhaust valve which have an inlet valve is formed in the location of the outside of

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained to a detail with reference to a drawing. Drawing 1 thru/or drawing 5 are drawings for explaining the injection type spark-ignition engine in a direct cylinder concerning the 1st operation gestalt of this invention. First, the sectional view showing the important section configuration of drawing 1 is referred to.

[0027] In drawing 1 , 11 is the cylinder head, and although the cylinder head 11 is omitting illustration, it is being fixed to the upper part of the cylinder block with which the piston by which the crevice was formed in a part of the crestal plane (top face) was fitted in.

[0028] Moreover, although illustration is omitted at the cylinder head 11, an ignition plug is attached in the outline center section, and the exhaust air passage which has the inhalation-of-air passage and the exhaust valve which have an inlet valve is formed in the location of the outside of an ignition plug. Outside, the fuel injection valve 12 which injects a fuel directly at the combustion chamber formed by the inside of a cylinder block, the crestal plane of a piston, and the inside of the cylinder head 11 is arranged at the pan of the inhalation-of-air passage of the cylinder head 11.

[0029] The attaching hole 13 in which a fuel injection valve 12 is attached and to penetrate is formed in the cylinder head 11, and the combustion chamber side (it is the bottom all over this drawing) of this attaching hole 13 is the hole where the cross section in which level difference side 13a was formed by forming this and the opposite side (it being the bottom all over this drawing) in a large diameter is circular in a narrow diameter as shown in drawing 1 .

[0030] The point of a fuel injection valve 12 (the near is included.) It is below the same. Since high degree of accuracy is required in order to make the suitable combustible gas mixture only for the field to which the circumference of an ignition plug was restricted by cooperation with the crevice of the crestal plane of a piston form, it is constituted by two or more components. That is, the point of a fuel injection valve 12 is equipped with the nozzle components 14, a plunger (needle valve) 15, the nozzle acceptance components 16, the fuel revolution component 17, and gas-seal member 18 grade, and is constituted.

[0031] The nozzle components 14 are the members formed in the shape of an outline cylinder, and they have the flange jutted out outside at the interstitial segment while they have fuel injection-tip 14a in the combustion chamber side edge section. The inside part of fuel injection-tip 14a of the nozzle components 14 is formed in the shape of a taper. The ring-like fuel revolution component 17 is arranged at the inside of the combustion chamber side edge section of the nozzle components 14 so that it may be located in the perimeter of fuel injection-tip 14a. The fuel revolution component 17 has two or more slot 17a, and at the time of fuel injection, a fuel circles and it is injected by operation of such slot 17a from fuel injection-tip 14a as shown in drawing 2 .

[0032] The plunger 15 is arranged inside the nozzle components 14. A tip is the member of the shape of an outline cylinder formed in the shape of a taper taper, and a plunger 15 opens and closes fuel injection-tip 14a by being slid in the direction in alignment with the axial center. In addition, the tip of a plunger 15 may be formed in the shape of a ball.

[0033] The nozzle acceptance components 16 are the members of the shape of an outline cylinder which has a through hole in the combustion chamber side edge section. While the nozzle components 14 are made from the inside this through hole of the nozzle acceptance components 16 insertion and fitting and the combustion chamber side edge section of the nozzle components 14 and its near project from the nozzle acceptance components 16 After the inside of the combustion chamber side edge section of the nozzle acceptance components 16 and the flange of the nozzle components 14 have contacted, the nozzle components 14 are being fixed to the nozzle acceptance components 16 in one.

[0034] Thus, the constituted fuel injection valve 12 is in the condition that the combustion chamber side edge section of the nozzle components 14 and its near were inserted in the thin diameter section of the attaching hole 13 of the cylinder head 11, and the nozzle acceptance components 16 were inserted in the large diameter section of the attaching hole 13 of the cylinder head 11, and is

an ignition plug. Outside, the fuel injection valve 12 which injects a fuel directly at the combustion chamber formed by the inside of a cylinder block, the crestal plane of a piston, and the inside of the cylinder head 11 is arranged at the pan of the inhalation-of-air passage of the cylinder head 11.
[0029] The attaching hole 13 in which a fuel injection valve 12 is attached and to penetrate is formed in the cylinder head 11, and the combustion chamber side (it is the bottom all over this drawing) of this attaching hole 13 is the hole where the cross section in which level difference side 13a was formed by forming this and the opposite side (it being the bottom all over this drawing) in a large diameter is circular in a narrow diameter as shown in drawing 1 .
[0030] The point of a fuel injection valve 12 (the near is included.) It is below the same. Since high degree of accuracy is required in order to make the suitable combustible gas mixture only for the field to which the circumference of an ignition plug was restricted by cooperation with the crevice of the crestal plane of a piston form, it is constituted by two or more components. That is, the point of a fuel injection valve 12 is equipped with the nozzle components 14, a plunger (needle valve) 15, the nozzle acceptance components 16, the fuel revolution component 17, and gas-seal member 18 grade, and is constituted.
[0031] The nozzle components 14 are the members formed in the shape of an outline cylinder, and they have the flange jutted out outside at the interstitial segment while they have fuel injection-tip 14a in the combustion chamber side edge section. The inside part of fuel injection-tip 14a of the nozzle components 14 is formed in the shape of a taper. The ring-like fuel revolution component 17 is arranged at the inside of the combustion chamber side edge section of the nozzle components 14 so that it may be located in the perimeter of fuel injection-tip 14a. The fuel revolution component 17 has two or more slot 17a, and at the time of fuel injection, a fuel circles and it is injected by operation of such slot 17a from fuel injection-tip 14a as shown in drawing 2 .
[0032] The plunger 15 is arranged inside the nozzle components 14. A tip is the member of the shape of an outline cylinder formed in the shape of a taper taper, and a plunger 15 opens and closes fuel injection-tip 14a by being slid in the direction in alignment with the axial center. In addition, the tip of a plunger 15 may be formed in the shape of a ball.
[0033] The nozzle acceptance components 16 are the members of the shape of an outline cylinder which has a through hole in the combustion chamber side edge section. While the nozzle components 14 are made from the inside this through hole of the nozzle acceptance components 16 insertion and fitting and the combustion chamber side edge section of the nozzle components 14 and its near project from the nozzle acceptance components 16 After the inside of the combustion chamber side edge section of the nozzle acceptance components 16 and the flange of the nozzle components 14 have contacted, the nozzle components 14 are being fixed to the nozzle acceptance components 16 in one.
[0034] Thus, the constituted fuel injection valve 12 is in the condition that the combustion chamber side edge section of the nozzle components 14 and its near were inserted in the thin diameter section of the attaching hole 13 of the cylinder head 11, and the nozzle acceptance components 16 were inserted in the large diameter section of the attaching hole 13 of the cylinder head 11, and is being fixed to the cylinder head 11.
[0035] Between the perimeter of the through hole of the combustion chamber side edge side of the nozzle acceptance components 16, and level difference side 13a of the attaching hole 13 of the cylinder head 11, the gas-seal member 18 of the shape of a ring for preventing leakage of the gas from a combustion chamber is infixed.
[0036] Near the thin diameter section of the attaching hole 13 of the cylinder head 11, the heater 19 which consists of heating wire which generates heat by energization is laid underground. Its ON/OFF (ON/OFF) is alternatively controlled by the heater control circuit as this heater 19 shown in drawing 3 in.
[0037] The heater control circuit is equipped with the control unit 23 which controls supply or cutoff of the power source to the heater 19 by the relay circuit 22 and relay circuit 22 which were

infixed in the middle of the heater wiring 21 connected to the dc-battery 20, and the heater wiring 21 according to the signal from various kinds of sensors.

[0038] A control unit 23 controls ON or OFF of a relay circuit 22 based on the signal from the sensor which detects the temperature near the point of a fuel injection valve 12 if needed [of detecting the water temperature of the sensor which detects oil temperatures, such as a lubricating oil, or a radiator / the signal and if needed] from a sensor.

[0039] It explains with reference to the flow chart which shows control by the control unit 23 to drawing 4 . This flow chart shows the processing in the case of controlling ON or OFF of a heater 19 based on an oil temperature or water temperature.

[0040] First, if an ignition switch is turned ON (ON) (1 "is displayed as ST by a diagram"), [step] It is judged whether an oil temperature or water temperature is 0 degree C or less (step 2), and when it is truth (T) (i.e., when an oil temperature or water temperature is 0 degree C or less) The relay-on signal which directs to perform energization to a heater 19 is sent to a relay circuit 22, and, thereby, energization is started by the heater 19 (step 3). Subsequently, it is judged whether the predetermined time amount T (second) set up beforehand passed (step 4), and when it is a false (F) (i.e., when predetermined time amount has not passed), a condition as it is is maintained.

[0041] In step 4, in truth (T) (i.e., when predetermined time amount passes), delivery and energization of as opposed to a heater 19 by this are intercepted in the relay off signal which directs to stop the energization to a heater 19 to a relay circuit 22, and heating is ended (step 5). Subsequently, cranking (fuel injection) is started (step 6). In step 2, when it is a false (F) (i.e., when an oil temperature or water temperature is 0 degrees C or more), cranking is started immediately (step 6).

[0042] In addition, time amount required to fully raise temperature near the point of a fuel injection valve 12 (for example, 0 degrees C or more) is found by experiment etc., and said predetermined time amount T is set up beforehand.

[0043] It explains with reference to the flow chart which shows other control by the control unit 23 to drawing 5 . This flow chart shows the processing in the case of controlling ON or OFF of a heater based on the temperature an oil temperature or water temperature, and near the point of a fuel injection valve.

[0044] First, if an ignition switch is turned ON (ON) (1 "is displayed as ST by a diagram"), [step] It is judged whether an oil temperature or water temperature is 0 degree C or less (step 2), and when it is truth (T) (i.e., when an oil temperature or water temperature is 0 degree C or less) The relay-on signal which directs to perform energization to a heater 19 is sent to a relay circuit 22, and, thereby, energization is started by the heater 19 (step 3). Subsequently, it is judged whether the temperature near the point of a fuel injection valve 12 is 0 degree C or less (step 4), and when it is a false (F) (i.e., when the temperature near the point of a fuel injection valve 12 is 0 degree C or less), a condition as it is is maintained.

[0045] In step 4, in truth (T) (i.e., when the temperature near the point of a fuel injection valve 12 is 0 degrees C or more), delivery and energization of as opposed to a heater 19 by this are intercepted in the relay off signal which directs to stop the energization to a heater 19 to a relay circuit 22, and heating is ended (step 5). Subsequently, cranking (fuel injection) is started (step 6). In step 2, when it is a false (F) (i.e., when an oil temperature or water temperature is 0 degrees C or more), cranking is started immediately (step 6).

[0046] Since according to the 1st operation gestalt of this invention mentioned above the point of a fuel injection valve 12 was heated at the heater 19 (when an oil temperature or water temperature is 0 degree C or less), entropy of the heat deformation of each part article which constitutes the point of a fuel injection valve 12 is carried out and expansion of the dispersion width of face of an injection property is controlled when engine temperature is low, the combustion stability at the time of cold machine starting can be improved.

[0047] That is, by the temperature gradient of the point of a fuel injection valve 12 and a

combustion chamber becoming small, and carrying out entropy of the heat deformation of each part article which constitutes the point of a fuel injection valve 12, for example, keeping suitable the relative physical relationship of the tip of a plunger (needle valve) 15, and fuel injection-tip 14a, injection properties, such as fuel oil consumption and spraying structure (spraying configuration), are stabilized, cylinder internal pressure fluctuation as shown in drawing 9 becomes low, and combustion stability improves. Therefore, the fall of an engine output, the increment in the noise, and extensive discharge of a still more poisonous unburnt gas can be prevented.

[0048] Although the heater 19 which heats the point of a fuel injection valve 12 was laid underground near the thin diameter section of the attaching hole 13 of the cylinder head 11 with the 1st operation gestalt of this invention mentioned above This invention is not limited to this but can acquire the same effectiveness as the 1st operation gestalt of this invention mentioned above even if it could lay underground in the thickness of the wall of the nozzle components 14 of a fuel injection valve 12 and constituted in this way in fuel injection valve 12 the very thing.

[0049] Next, the 2nd operation gestalt of this invention is explained with reference to drawing 6 and drawing 7 . The number same about the same component is substantially attached with the 1st operation gestalt of this invention mentioned above, and the explanation is omitted.

[0050] A heater 19 is not laid under the cylinder head 11, but it is made to build in a gas-seal member like the 1st operation gestalt mentioned above in this 2nd operation gestalt. That is, between the perimeter of the through hole of the combustion chamber side edge side of the nozzle acceptance components 16, and level difference side 13a of the attaching hole 13 of the cylinder head 11, the gas-seal member 24 with a heater of the shape of a ring in which the heater was built is infixed.

[0051] This gas-seal member 24 with a heater consists of the seal section 25 which takes charge of the function of the gas-seal member 18 in the 1st operation gestalt mentioned above, i.e., the function to prevent leakage of the gas from the clearance between a fuel injection valve 12 and the cylinder head 11, and the heater section 26 by which heating-wire 26a was held in the interior. A fuel injection valve 12 and the cylinder head 11 are heated by energizing by the heater control circuit shown in heating-wire 26a of this heater section 26 at drawing 7 .

[0052] Other configurations, the flows of control by the heater control circuit, and the operation effectiveness are the same as the 1st operation gestalt mentioned above.

[0053] However, in addition to effectiveness, such as improvement in combustion stability, with this 2nd operation gestalt, the conventional injection type spark-ignition engine in a direct cylinder is received. Since it can respond only by exchanging the seal member for said gas-seal member 24 with a heater, there is no need of carrying out the design change of cylinder head 11 and fuel injection valve 12 the very thing and the number of components does not increase, either An injection property and combustion stability can be improved without raising cost so much.

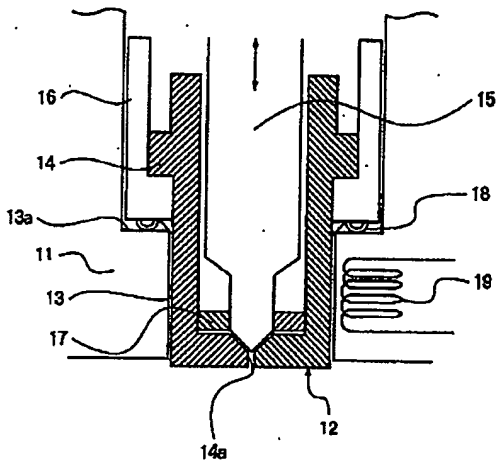
[0054] Moreover, of course, the gas-seal member 24 with a heater of this 2nd operation gestalt may be applied to the 1st operation gestalt mentioned above.

[0055] In addition, the operation gestalt explained above was indicated in order to make an understanding of this invention easy, and it was not indicated in order to limit this invention. Therefore, each element indicated by the above-mentioned operation gestalt is the meaning also containing all the design changes belonging to the technical range of this invention, or equal objects.

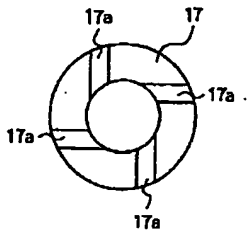
TECHNICAL FIELD

[Field of the Invention] This invention relates to the injection type spark-ignition engine in a direct cylinder which attaches a fuel injection valve in the cylinder head, and becomes it at a combustion chamber that a direct fuel should be injected.

【図1】



【図2】



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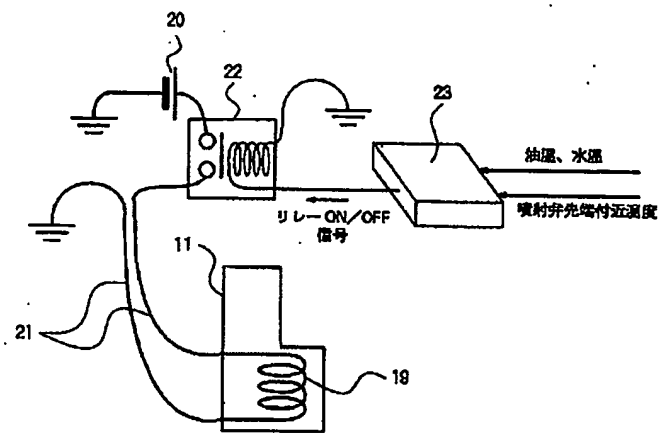

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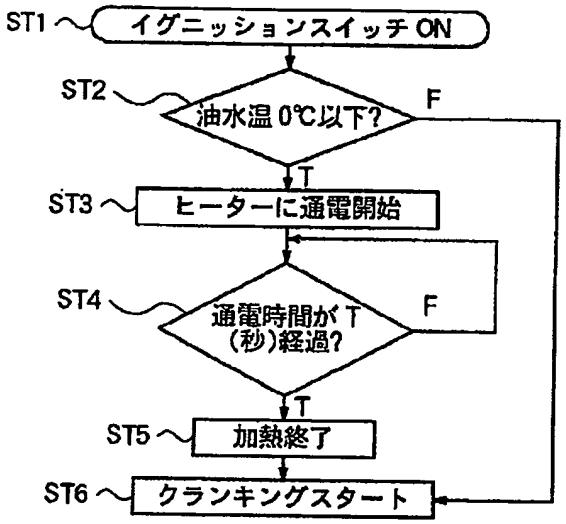

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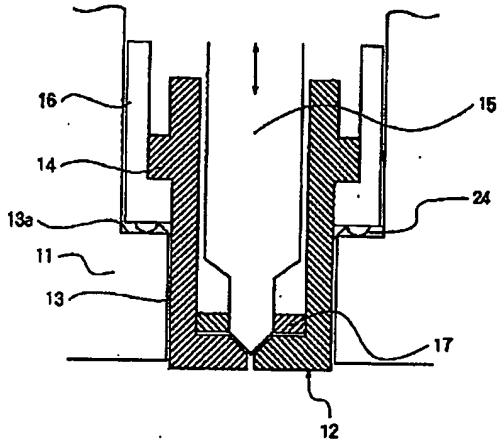

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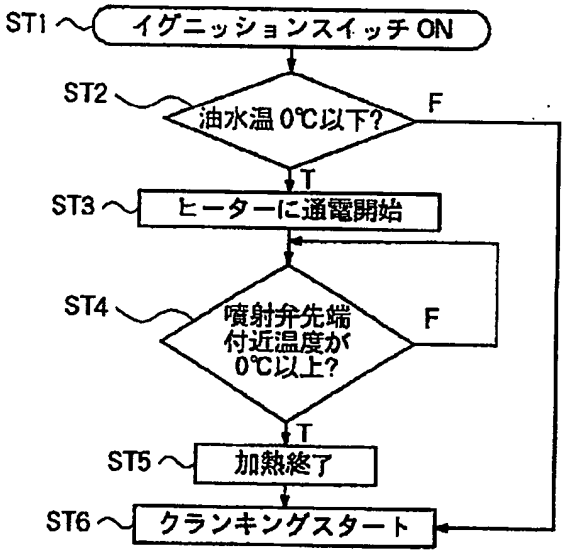

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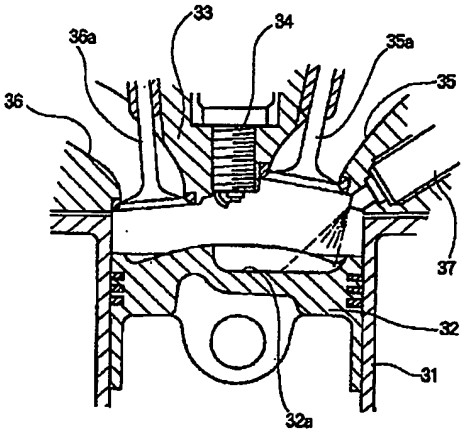

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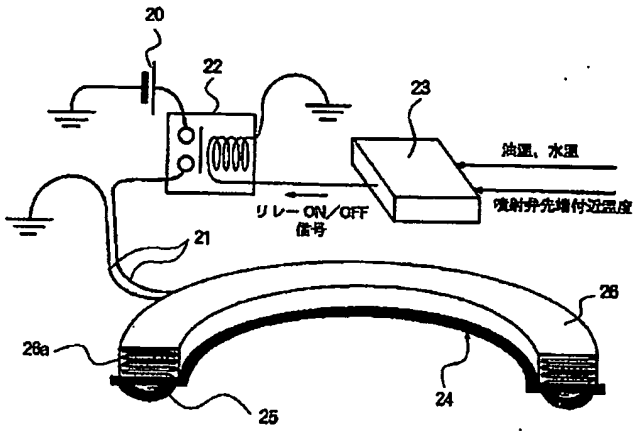

【図9】